the increase in the ultrasonic amplitude, the temperature and pressure curves both had a higher peak. The growth in temperature and pressure at the collapse is attributable to the increase in the energy absorbed by the bubble under negative pressure when the ultrasonic amplitude widens.

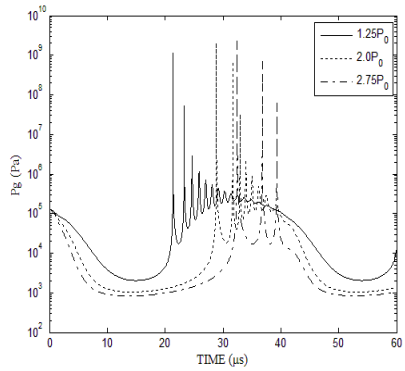

Figure 15. The time-varying patterns of bubble pressure with different ultrasonic amplitudes

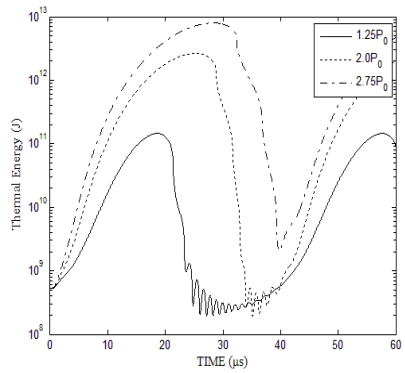

Figure 16. The time-varying patterns of the number of vapor molecules with different ultrasonic amplitudes

Figure 16 shows the variation in the number of vapor molecules over the time. As the ultrasonic frequency increased, the number of vapor molecules in the bubble was on the rise. The trend can be explained as follows. The net evaporation rate mainly relies on bubble temperature and bubble pressure. The greater the ultrasonic amplitude, the lower the bubble in the expansion phase. Under a high net evaporation rate increases, the ultrasonic amplitude and the bubble radius will be relatively large, pushing up the number of vapor molecules in the bubble.

5. CONCLUSION

This paper simulates the ultrasonic cavitation on Matlab considering the water evaporation and vapor condensation. Various influencing factors were introduced to analyse the bubble motion, including initial radius, ultrasonic frequency and ultrasonic amplitude. The motion of the bubble was characterized by such parameters as radius, temperature, pressure, internal energy and the number of vapor molecules. Through the simulation, it is discovered that the change of the initial radius had a little impact on the bubble temperature and bubble pressure. However, the radius variation exerted an obvious influence on the other motion parameters. These parameters shared a similar change pattern. For ultrasonic frequency, the change in frequency had a limited effect on the bubble temperature and bubble pressure, but a significant impact on the other motion parameters. These parameters varied in different ranges. In addition, the ultrasonic amplitude had a rather prominent impact on all motion parameters of the cavitation bubble.

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REFERENCES

[1] Du X.M., Dang Z., Zhang Z.F., Bai B.F. (2011). Hydrogen production from sonolysis of aqueous methanol solution, *CIESC Journal*, Vol. 62, No. 6, pp. 1669-1674. DOI: 10.3969/j.issn.0438-1157.2011.06.029

[2] Plesset M.S., Hsieh D. (1960). Theory of gas bubble dynamics in oscillating pressure fields, *Physics of Fluids*, Vol. 3, No. 6, pp. 882-892. DOI: 10.1063/1.1706152

[3] Noltingk B.E., Neppiras E.A. (1950). Cavitation produced by ultrasonics, *Proceedings of the Physical Society. Section B*, Vol. 63, No. 9, pp. 674-685.

[4] Gilmore F.R. (1952). The growth or collapse of a spherical bubble in a viscous compressible liquid, California Institute of Technology, Pasadena, USA, p. 561.

[5] An Y., Ying C.F. (2005). Model of single bubble sonoluminescence, *Physical Review E Statistical Nonlinear & Soft Matter Physics*, Vol. 71, No. 3, p. 036308. DOI: 10.1103/PhysRevE.71.036308

[6] Wang P.H. (2003). The influencing factors of ultrasonic cavitation, *Journal of Hebei Institute of Technology*, Vol. 25, No. 4, pp. 154-161. DOI: 10.3969/j.issn.1674-0262.2003.04.029

[7] Xu W.L., He Y.F., Wang Y.Q. (2005). Solution and process simulation of ultrasonic cavitation bubble motion equation, *Journal of Yangzhou University (Natural Science Edition)*, Vol. 8, No. 1, pp. 55-59, 68. DOI: 10.3969/j.issn.1007-824X.2005.01.014

[8] Yasui K. (1996). Variation of Liquid temperature at bubble wall near the Sonoluminescence Threshold, *Journal of the Physical Society of Japan*, Vol. 65, No. 9, pp. 2830-2840. DOI: 10.1143/JPSJ.65.2830

[9] Yasui K. (1995). Effects of thermal conduction on bubble dynamics near the sonolumiescence Threshold, *Journal of the Acoustical Society of America*, Vol. 98, No. 5, pp. 2772-2782. DOI: 10.1121/1.413242

[10] Yasui K. (1997). Alternative model of single-bubble sonoluminecence, *Physical Review E*, Vol. 56, No. 6, pp. 6750-6760. DOI: 10.1103/PhysRevE.56.6750

[11] Shen Y., Yasui K., Sun Z.H., Mei B., You M.Y., Zhu T. (2016). Study on the spatial distribution of the liquid temperature near a cavitation bubble wall, *Ultrasonics Sonochemistry*, Vol. 29, pp. 394-400. DOI: 10.1016/j.ultsonch.2015.10.015